

INDIA WEATHER REVIEW, 1964

ANNUAL SUMMARY

1964

2000

PART C

STORMS

AND DEPRESSIONS

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Information Manufacturing Corporation
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September 14, 1999

INDIA WEATHER REVIEW, 1964

ANNUAL SUMMARY

PART - C

STORMS AND DEPRESSIONS

I. DEPRESSIONS AND CYCLONIC STORMS

During the year, four cyclonic storms and eight depressions formed in the Bay of Bengal and three cyclonic storms in the Arabian Sea. One cyclonic storm emerged into the Arabian Sea as a depression. A land depression also developed over Gangetic West Bengal. The tracks of the storms and depressions are given in Figure 1. The dates of activities of the storms and the greatest barometric depths observed near the centres are given in the Table I below :

TABLE I

Locality	Month	Date	Greatest observed/ estimated barometric depth
Bay of Bengal	May	5 - 9	17 mb
Arabian Sea	June	9 - 13	38 mb
Arabian Sea	August	6 - 7	16 mb
Arabian Sea	November	2 - 8	— —
Bay of Bengal	November	3 - 8	20 mb
Bay of Bengal	November	16 - 28	21 mb
Bay of Bengal	December	17 - 24	38 mb

The monthly distribution of the storms and depressions for the year 1964 is given in Table II at the end.

The detailed description of the storms and depressions are given below :

1. Cyclonic storm in the Bay of Bengal—
—6th to 9th May—

A low pressure wave moved from the east into the south Andaman Sea by the end of April. It was lying over the extreme southeast Bay of Bengal on the morning of 1st May as a cyclonic circulation between 900 m and 3.0 km a.s.l. This cyclonic circulation gradually moved westwards, descended to the surface and a low pressure area formed over the southwest Bay of Bengal off east coast of Ceylon by the 3rd morning. It was persisting over the same area on the 4th and the associated upper air cyclonic circulation extended upto 3.0 km a.s.l. Subsequently, it moved northwards and then recurving northeastwards, concentrated into a depression by the morning of 6th with centre near 12.5°N and Long.86.5°E. By the next morning, it moved eastnortheastwards and intensified into a cyclonic storm with centre near Lat. 13°N, Long. 89°E.

There were no ships close to the centre of the system at this time. However, ship Pcuk at position Lat.14.9°N, Long.92.7°E reported southerly wind of 20 kts and pressure 1001.8 mb at 0530 hrs IST of 7th. Port Blair reported southwesterly surface wind of 15 kt at 0830 hrs IST with pressure 1005.0 mb which was 4.2 mb below normal. Port Blair also reported squall of 35 kt from southwesterly direction at 0600 hrs IST on this day. There was also a general fall of pressure over the Bay Islands which was of the order of 0.5 to 1.5 mb. At 1730 hrs IST of 7th, Ship Pcuk at Position Lat.12.2°N, Long.90.4°E reported surface wind S/37 kt and high seas. Port Blair reported surface wind SW/25 kt and pressure 1001.1 mb which was 5.8 mb below normal. The storm was practically stationary till the evening of 7th.

On the morning of 8th, 0830 hrs IST surface pressure at Coco Island and Rangoon fell by about 2 mb. Coco Island reported surface wind WSW/20 kt and pressure 1002.1 mb. The upper winds at this station were SSW/30-40 kt upto 1.5 km a.s.l. Port Blair also reported westsouthwesterly 30 kt and 35 kt at 600 m and 900 m a.s.l. respectively. The belt of rainfall extended from the Bay Islands to Burma coast and upto Assam and Sub-Himalayan West Bengal. The cyclonic storm was centred near Lat.15.5°N, Long.92°E at 0830 hrs IST of 8th. Moving in a northnortheasterly direction, the storm was centred at 1730 hrs IST of 8th near Lat.17.5°N, Long. 93.0°E. Coco Island reported surface wind WSW/20 kt and Bassein southerly 15 kt, pressure 996.8 mb. The departure from normal of Bassein pressure at 1730 hrs IST of 8th was -8.6 mb. Continuing to move in a northnortheasterly direction, the storm crossed the north Arakan coast near Lat. 20°N during the course of the night of 8-9th and rapidly weakened into a depression. It was centred near Lat.22.5°N, Long.94.0°E on the morning of 9th. It rapidly weakened further into a low pressure area and moved away northwards.

The estimated lowest pressure associated with this system was 992 mb at 0830 hrs IST of 8th and the corresponding negative pressure departure was about 17 mb.

Under the influence of this system, the southwest monsoon advanced into the southeast Bay of Bengal upto Lat.10°N and the south Bay Islands. The Bay Islands received good rainfall during this period. Some of the noteworthy amounts of rainfall were :

5th	Port Blair	5 cm
6th	Car Nicobar	6 cm
7th	Port Blair	8 cm
	Car Nicobar	5 cm
9th	Long Island	8 cm
10th	Port Blair	11 cm
	Car Nicobar	5 cm
	Kondul	5 cm

2. Severe cyclonic storm in the Arabian Sea—
—9th to 13th June—

The southwest monsoon set in over Kerala on 5th June. A trough of low pressure developed over the east central Arabian Sea off Karwar coast by the morning of 6th. It gradually moved northwards, became well marked by 8th morning and developed into a low pressure area by the same evening off south Konkan coast. On the morning of 9th, the low pressure area concentrated into a depression with centre near Lat. 17°N, Long. 71°E. The associated upper air cyclonic circulation extended upto 6.0 km a.s.l. Ship AQEN which was lying about 100 km west of Devgarh reported surface wind southerly 25 kt and pressure 998.5 mb at 0530 hrs IST. Moving northnorthwestwards, it intensified into a deep depression by mid-night. Ship VWPV located at Lat. 18.6°N, Long. 70.0°E reported an easterly surface wind of 30 kt at 2330 hrs IST of 9th. Upper winds at Bombay were southeasterly 25, 30 and 30 kt at 600 m, 900 m and 1.5 km a.s.l. respectively. By the morning of 10th, the system intensified into a cyclonic storm centred near Lat. 18.5°N, Long. 70.5°E. Pressures all over Konkan and Gujarat State started falling and the larger falls were along the south Saurashtra coast. The upper winds at Bombay had also strengthened and were southsoutheasterly 30 and 35 kt at 600 and 900 m a.s.l. respectively, at 0530 hrs IST. Ship FOBQ located near Lat. 20.4°N, Long. 70.8°E reported at 1130 hrs IST surface wind 130/35 kt. The weather along the Saurashtra coast had also started deteriorating by this time. Continuing to move northnorthwestwards, the cyclonic storm was centred at 1730 hrs IST of 10th near Lat. 19.5°N, Long. 70.0°E. The system intensified into a severe cyclonic storm by the morning of 11th. Upper winds at Veraval began strengthening and the winds were ESE/35 kt at 600 m and ESE/55 kt at 900 m a.s.l. at 2330 hrs IST of 10th.

Continuing its northnorthwesterly course, the severe cyclonic storm with a core of hurricane winds was centred at 0830 hrs IST of 11th near Lat. 21°N, Long. 69°E. Veraval reported surface winds SSE/40 kt and pressure 995.1 mb at 0830 hrs IST and the corresponding pressure depth was 7.4 mb. Porbandar reported surface wind E/30 kt with pressure 994.4 mb at the same time. No upper wind observations over the field of the system were available at

this time on this day except that of Veraval which reported wind SSE/35 kt at 300 m a.s.l. The severe cyclonic storm continued to move northnorth-westwards and was centred at 1730 hrs IST of 11th about 40 km southwest of Dwarka. Later, the storm moved in a northerly direction, recurved towards northnortheast and was centred at 0830 hrs IST of 12th close to Naliya. Naliya reported the strongest surface wind of 75 kt from easterly direction and surface pressure 973.2 mb at 0830 hrs IST on this day. The lowest pressure 969.5 mb was recorded by Naliya at 0930 hrs IST. From all the available data, it would appear that the eye of the storm had crossed Jhakau which is about 20 km westsouthwest of Naliya. The winds which were blowing hard at Jhakau all through the night of 11th, became calm by about 8 A.M. the next day and the sky cleared. Naliya also came within the central calm or weak wind zone of the storm. The surface wind at Naliya which reached the peak value of 75 kt at 0830 hrs IST on 12th dropped to 18 kt at 1030 hrs IST. The cyclonic circulation associated with the system extended upto about 12 km on the morning of 12th.

After crossing the coast, the severe cyclonic storm rapidly weakened into a depression and moving northeastwards was centred near Badin (West Pakistan) on the evening of 12th and near Barmer (West Rajasthan) on the morning of 13th. It later weakened into a trough of low pressure over northeast Rajasthan and adjoining Punjab by the evening of the same day.

Ship MV Dumra, plying towards Bombay, passed very near the centre of the cyclonic storm on 11th evening and provided useful hourly observations. These are given below :

EXTRACTS FROM THE DECK LOG OF MV DUMRA ON 11TH

Time IST	Position		Wind		Pressure (mb)	Temp °C	Remarks
	Lat. °N	Long °E	Dir. Deg.	Speed Knots			
0500			090	11	1001.6		
0600			090	16	1000.6		0800: Occasional
0700			110	21	1000.6		Light showers, clear,
0800	22.36	68.18	070	27	999.6	29	Mainly overcast.
							Moderate/rough beam swell
							and sea. Vessel pitching
							easily. Occasional sprays.
0900			060	34	998.9		1200: Overcast, Raining.
1000			050	37	997.9		Moderate visibility in
1100			050	37	996.9		rain. Very rough seas,
1200	22.13	68.40	060	37	994.5	27	heavy swells. Vessel
							pitching.
1300			050	37	991.2		1600: Vessel pitching
1400			080	44	987.4		heavily in very rough
1500			110	52	984.0		seas and heavy swells.
1600	22.0	68.54	100	60	978.6		

Time IST	Position		Wind		Pressure (mb)	Temp °C	R e m a r k s
	Lat. °N	Long °E	Dir. Deg.	Speed. Knots.			
1700			140/60	60	979.3		2000: Occasional rain with poor visibility. Mainly overcast. Very rough beam seas and heavy swell. Vessel rolling at times heavily taking heavy water.
1800			180	52	982.7		
1900			180	52	984.7		
2000			190	52	987.4	27	
2100			215	52	990.1		2400: Occasional rain-squall, visibility good, very rough beam seas and heavy swell. Vessel rolling and pitching and taking water on star-board side.
2200			220	48	991.8		
2300			225	37	994.2		
2400	21.32	69.25	230	30	996.2	28	
12th June							
0100			240	34	997.2		0400: Rain, overcast vessel rolling and pitching heavily at times in rough seas and heavy swell
0200			230	34	997.6		
0300			230	34	997.6		
0400	21.05	69.54	200	34	997.6	29	
0500			200	34	998.9		0800: Fair clear 7/8/ cloud, rough seas and very heavy beam swell. Vessel rolling and pitching at times heavily. Good visibility.
0600	20.40	70.23	215	21	1000.0		
0700			210	21	1001.3		
0800			210	21	1003.0	29.5	
1200			200	16	1005.4	29.5	Fine and clear 2/8 clouds. Good visibility. Moderate swell. Rough to moderate seas.

The hourly observations recorded at Porbandar, Dwarka and Naliya on 11th and 12th June are also given below :

Date	Time IST.	W i n d		Pressure (mb)
		Dir. Deg.	Speed Knots	

PORBANDAR

11/6	1330	140	38	992.8
	1430	140	42	992.0
	1530	160	40	991.5
	1630	160	40	991.6
	1730	180	35	992.1
	1830	180	41	992.0
	1930	180	42	992.6
	2030	180	38	993.3
	2130	180	35	993.9
	2230	180	37	994.4
	2330	200	38	995.2
12/6	0030	200	35	995.4
	0130	200	36	994.8
	0230	200	37	994.4
	0330	200	33	994.4
	0430	200	35	994.8
	0530	200	33	995.1
	0630	230	32	996.0

DWARKA

11/6	1630	090	15	988.6
	1730	090	30	985.9
	1830	090	50	983.6
	1930	090	30	983.0
	2030	090	40	983.9
	2130	090	40	983.7
	2230	140	55	984.0
	2330	140	50	983.8
12/6	0030	230	50	983.9
	0130	230	47	984.0
	0230	230	45	984.9
	0330	230	50	986.0
	0430	230	50	986.3
	0530	230	50	986.9
	0630	230	55	988.9
	0730	230	50	989.1
	0830	230	50	991.5

Date	Time IST.	W i n d		Pressure (mb)
		Direction Degrees	Speed Knots	

NALIYA

12/6	0230	050	44	988.5
	0330	020	51	983.8
	0430	050	51	985.4
	0530	050	54	982.6
	0630	070	69	980.2
	0730	070	65	978.7
	0830	090	75	973.2
	0930	090	59	969.5
	1030	160	18	970.3
	1130	180	36	971.2
	1230	230	53	978.2
	1330	230	56	982.8
	1430	230	56	986.2
	1530	230	52	996.2

This severe cyclonic storm with a core of hurricane winds did not cause much rainfall. Some of the noteworthy amounts of rainfall associated with this system are reproduced below :

9th	Goa	9 cm
	Harnai	4 cm
10th	Veraval	4 cm
	Goa	4 cm
11th	Porbandar	7 cm
	Ratnagiri	6 cm
	Harnai	5 cm
	Veraval	3 cm
12th	Bhuj	3 cm
	Veraval	3 cm

According to press reports, the cyclonic storm whipped up high intensity tidal waves, damaging many houses on the sea coast. The worst damage was reported from Naliya, Jamnagar, Jhakau, Porbandar and Dwarka and relatively minor damage from Bhaunagar, Rajkot, Kandla, Surat and Mahuva. Six steamers in Bedi port near Jamnagar were drifted into the sea, many country crafts sank and a barge loaded with bauxite capsized in the stormy sea. 27 persons lost their lives due to the cyclone. Two to three furlongs of Asmavathi road

together with the 25 ft wide basement foundation of the 20 ft high protection wall along the sea coast was completely washed away at Porbandar. Tidal waves were reported to have risen higher than at any time in the past at most of the ports.

At Porbandar, the tidal waves were understood to have been about 6 m high and the storm tide about 1.2 m. At Kandla, the storm tide was about 2 m high, at Okha and Navlakhi about 1 m high. One ship "Kadia" was lost between Veraval and Porbandar. A railway line near Cambay was washed away. Huge quantities of salt were washed away from salt pans at Jhakau and Naliya.

The lowest surface pressure of 969.5 mb was recorded at Naliya at 0930 hrs IST on 12th. At this time the storm centre was about 10 km away. Allowing for a pressure gradient of 0.6 mb/km to prevail in the innermost core of the storm, the central pressure works out to about 964 mb and the corresponding pressure defect would be about 38 mb.

3. Deep depression in the Bay of Bengal— —3rd to 6th July—

The axis of the monsoon trough was extending into the head Bay of Bengal from 1st July. A low pressure wave was moving westwards across Central Burma on the morning of 2nd as could be inferred from the fall of pressure over this area. By the evening of 2nd, higher pressure falls were noticed along the Arakan coast and a feeble upper air cyclonic circulation could also be seen upto 600 m a.s.l. over the northeast and adjoining east central Bay of Bengal. Under its influence, a trough of low pressure developed over the north Bay of Bengal. By the morning of 3rd, a depression formed over the head Bay of Bengal with centre near Lat. 21.0°N, Long. 89.5°E.

The following observations are significant in this connection :

Date	Name of the ship/ station	Position		Time of Obsn. IST	Wind		Pres- sure mbs.	Weather
		Lat. °N	Long °E		Dir.	Speed Knots		
3rd	Calcutta			0830	NE	5	994.4	-
	Khulna			0830	E	15	996.5	-
	Sandheads			0830	NE	15	991.5	Rain
	Akyab			0830	SSE	5	997.0	Rain
	AQBT	20.3	89.0	0530	W	15	992.0	Rain

The pressure departures from normal were of the order of —6 to —8 mb over the north Bay. The associated upper air cyclonic circulation was extending upto about 6.0 km a.s.l. Moving in a northwesterly direction, the depression was centred near Lat. 21.5°N, Long. 89.0°E on the evening of 3rd. Sandheads surface wind which was northeasterly in the morning backed and became

westerly/20 kts in the evening. The cyclonic circulation associated with the depression was extending upto 7.2 km a.s.l. By 2330 hrs IST, the upper winds at Calcutta and Cuttack had strengthened. Cuttack reported easterly wind 20 kt upto 3.0 km a.s.l. and Cuttack westerly/30 kt at 600 m, WNW/30 kt at 900 m and WNW/20 kt at 1.5 km a.s.l. suggesting that the depression has further intensified into a deep depression by this time. At 0830 hrs IST of 4th, pressures fell further of the order of -4 to -4.5 mb at Calcutta, Balasore and Sagar Island. The highest pressure departure of -11 mb was at Sagar Island. Orissa coast experienced heavy to very heavy rain. The deep depression was practically stationary at this time centred near Lat. 21.5°N , Long 89.0°E .

In this connection the following observations are of interest :

Date	Name of the ship/station	Position		Time of Obsn. IST	Wind		Pre-ssure (mb)	Weather
		Lat. $^{\circ}\text{N}$	Long. $^{\circ}\text{E}$		Dir.	Speed Knots		
4th	Sagar Island			0830	NNE	20	989.1	Drizzle
	Sandheads			0830	NNW	10	988.3	Rain in last hour
	AGLC	16.5	89.5	0530	SW	25	990.0	Overcast

Thereafter, the deep depression moved rather rapidly in a westnorth-westerly direction, crossed north Orissa - West Bengal coast near Contai by late afternoon and was centred at 1730 hrs IST near Midnapore. Continuing to move westnorthwestwards, it weakened into a depression and was centred about 100 km southsoutheast of Daltonganj on the morning of 5th and about 100 km southsoutheast of Allahabad on the morning of 6th. Later it weakened into a well marked low pressure area which lay on the morning of 7th over southwest Uttar Pradesh. It merged with the seasonal low by the next morning.

The estimated lowest pressure and the corresponding negative departure from normal during the life span of this system was 987 mb and above 12 mb respectively at 0830 hrs IST on 4th.

This system was responsible for advancing the monsoon over Punjab and West Rajasthan. It was also responsible for the maintenance of good monsoon activity over the country. The monsoon was particularly strong over the central belt of the country extending from Orissa to Gujarat State and over the Konkan and Kerala. The following statement gives the particularly heavy falls in cm :

Date	Station	Rainfall (cm)	Date	Station	Rainfall (cm)
3	Kanas	19.0	5	Himagiri	19.4
	Tirtal	11.2		Titlagarh	15.5
4	Mohanga	37.7		Jharsuguda	10.0
	Paikamal	19.7	6	Hirakud	27.7
	Sohalla	15.3			
	Bhubaneshwar	10.5			

4. Deep depression in the Bay of Bengal 5th and 6th August

An upper air cyclonic circulation extending between 2.1 and 5.4 km a.s.l. developed over the west central and the adjoining northwest Bay of Bengal on the morning of 3rd August. Under its influence, a feeble low pressure area formed over the northwest Bay of Bengal by the same evening and the cyclonic circulation extended upto 5.4 km a.s.l. The feeble low persisted over the northwest Bay on the next day and concentrated into a depression by 0830 hrs IST on 5th with centre near 19.5°N , Long. 88.0°E . In this connection the following observations are relevant :

Date	Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
		Lat. $^{\circ}\text{N}$	Long. $^{\circ}\text{E}$		Dir.	Speed Knots		
5th	Sandheads			0830	E	15	996.3	
	Gopalpur			0830	NNW	5	997.3	
	Chandbali			0830	ENE	2	997.4	
	PCYE	17.3	87.2	0530	W	20	999.4	Rain in Sight
	GBCS	15.8	91.1	0830	SW	35	998.4	Rain

The depression moved slowly in a westerly direction and was centred near Lat. 19.5°N , Long. 87.5°E at 1730 hrs IST of the same day. Continuing to move west, it intensified into a deep depression with centre near Lat. 19.5°N , Long. 86.5°E at 0830 hrs IST on 6th. The pressure departures in the field of the system were of the order of -9 mb at this time. Upper winds of Calcutta and Cuttack were of the order of 30-35 kt upto 1.5 km a.s.l. and cyclonic circulation extended upto about 9.0 km a.s.l. sloping southwards with height. Moving further westwards, the deep depression crossed south Orissa coast near Puri in the evening and was centred about 50 km north of Gopalpur at 1730 hrs IST. Thereafter it rapidly weakened into a low pressure area over north Orissa and adjoining east Madhya Pradesh on the 7th. Moving northwestwards, the low pressure area merged into the seasonal trough by 9th.

The estimated lowest pressure associated with this system was 990 mb at 0830 hrs IST of 6th and the corresponding departure from normal was -11 mb.

The system was responsible for active monsoon conditions in the northeastern parts of the Peninsula and the central parts of the country.

The following statement gives the noteworthy amounts of rainfall associated with the depression:

Date	Station	Rainfall (cm)
5	Kumaria	11.7
	Arang .	10.8

Date	Station	Rainfall (cm)	Date	Station	Rainfall (cm)
6	Tangrapalli	26.7	7	Bundi	12.8
	Hamir	19.0		Kerkai	10.9
	Khamaria	16.7			
	Bhupalpatnam	14.1	8	Sehore	13.5
	Urmal	12.5			
	Jagdarpur	12.3			
	Kondagaon	11.6			
	Kojra	10.7			
	Dhantewana	10.2			
	Kerkai	10.2			

5. Cyclonic storm in the Arabian Sea—
—6 and 7 August—

An upper air cyclonic circulation between 1.5 and 5.4 km a.s.l. was lying off the Konkan coast on 2nd August. It gradually moved northwards and was lying over the Gulf of Cambay and adjoining Konkan coast on the morning of 4th. At this time, the circulation was extending between 2.1 and 6.0 km a.s.l. By the evening of 5th, there was a good fall of pressure off the Konkan coast and their departure from normal was of the order of -4 mb over the Konkan and south Saurashtra. A trough of low pressure had also developed off the Konkan coast and the adjoining Gulf of Cambay. The upper air cyclonic circulation was seen between 1.5 and 6.0 km a.s.l. By the 6th morning, a low pressure area had formed over the Gulf of Cambay and adjoining Konkan coast. The cyclonic circulation associated with the low extended upto 6.0 km a.s.l. sloping southwards with height. By the evening of 6th, the low pressure area concentrated into a depression with centre near Lat. 19.0°N, Long. 71.5°E. The pressure departures over Konkan and south Gujarat State were of the order of -7 to -9 mb. The system remained practically stationary and intensified into a cyclonic storm by the morning of 7th. Bombay and Dahanu had pressure departures of -9.8 and -9.0 mb respectively. The upper winds at Bombay strengthened considerably and they were southerly 30 kt and 35 kt at 300 and 600 m, southwesterly 35 kt at 900 m and southerly 30 kt at 1.5 km and 2.1 km a.s.l. In this connection, the following observations are also of interest.

Date	Name of the ship/station	Position		Time of Obsn	Wind		Pressure mb	Weather
		Lat. °N	Long °E		Dir.	Speed Knots		
7th	Colaba			0830	SW	10	996.3	Drizzle
	Dahanu			0830	SE	10	995.3	Overcast
	Veraval			0830	N	10	996.4	Overcast
	VWCF	19.7	71.8	1130	E	30	995.0	Showers

By the evening, the cyclonic storm had moved northeastwards and was centred near Lat. 19.5°N , Long. 72.0°E . Dahanu reported the lowest pressure of 989.7 mb and southeasterly wind of 40 kt. The pressure departure at Dahanu was -13 mb at this time. Bombay reported westsouthwesterly wind of 30 kt at 300 m and 35 kt at 600 m, 900 m and 1.5 km a.s.l. respectively at 1730 hrs IST. They were southwesterly 35 kt at 2.1 and 3.0 km a.s.l. Veraval reported easterly wind 30 kt at 300 and 600 m a.s.l. and easterly wind of 15 kt at 900 m a.s.l. The storm took a northerly course and then recurving northwestwards, rapidly weakened during the course of the night. It lay over Saurashtra and Kutch as a low pressure area on the morning of 8th and gradually weakened into a trough of low over Kutch by 9th morning.

The estimated lowest pressure during the life span of this storm was 987 mb at 1730 hrs IST of 7th and the corresponding pressure defect was about 16 mb.

The storm caused heavy rains and squally weather in Konkan. According to press reports, two persons were killed on 7th, when squally winds accompanied by heavy rains lashed Bombay. Two small ships in midstream broke loose from their moorings. Very extensive damage to plantain and chiku in Thana district was also reported.

Some of the principal reported amounts of rainfall in cm associated with this system were : Harnai 14 and Goa 9 on 6th, Radhanagari 24, Ratnagari 16, Devgarh 14, Belgaum 11, Kolhapur and Harnai 9 each on 7th and Radhanagari 46, Mahabaleshwar 16 and Bhira 10 on 8th.

6. Deep depression in the Bay of Bengal— —10th to 12th August—

On the morning of 8th August, the axis of the monsoon trough was extending into the northwest Bay of Bengal. A low pressure wave was also moving from the east across central Burma at the same time. By 9th morning, the low pressure wave had emerged into the north Bay of Bengal, where a low pressure area formed. The cyclonic circulation associated with the low extended upto 4.5 km a.s.l. It became well marked by the same evening and concentrated into a deep depression by the morning of 10th, centred near Lat. 19.5°N , Long. 88.5°E . In this connection the following observations of 10th are of interest:

Name of the ship/station	Position		Time of Obsn	Wind		Pressure (mb)	We a t h e r
	Lat. $^{\circ}\text{N}$	Long $^{\circ}\text{E}$		Dir.	Speed Knots		
Sandheads			0830	E	20	991.8	
VWTL	19.0	86.2	0530	N	20	987.2	Moderate rain
AQLN	18.2	89.3	0530	WSW	20	989.7	Drizzle
VWPT	16.4	89.7	0530	SW	25	997.2	-
VWTL	19.5	86.8	1130	NE	20	989.4	Showers

Name of the ship/station	Position		Time of Obsn	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
Calcutta			0530	E	15@		
				ENE	15*		
				ENE	15°		
Chittagong			0530	SE	30@		
				SE	45*		
				ESE	40°		
Cuttack			0530	NNE	35@		
				NNE	40*		
Gopalpur			0530	N	25@		
				NNE	30*		
				NE	35°		

@ at 600 m * at 900 m ° at 1.5 km

The cyclonic circulation extended upto about 6.0 km a.s.l. The pressure departures in the field of the system were of the order of -8 to -9 mb. Moving northwestwards, the deep depression was centred near Lat. 20°N, Long. 87.5°E at 1730 hrs IST of the same day. Sandheads reported surface wind ESE/20 knots and pressure 986.5 mb, which was 12 mb below normal. Continuing its northwesterly movement, the deep depression crossed the Orissa coast near Chandbali during the night of 10-11th and was centred about 100 km west of Balasore on the morning of 11th. Continuing its northwesterly movement, the deep depression was centred about 80 km southeast of Ambikapur on the evening of 11th and near Jabalpur on the morning of 12th. Later, it started weakening and continuing its northwestwards movement, was centred as a depression near Rajgarh in west Madhya Pradesh by the evening of 12th. It weakened further into a low pressure area by 13th morning, when it was lying over northeast Rajasthan and later merged with the seasonal low.

Under the influence of this depression, active monsoon conditions prevailed over Orissa on 11th. Fairly widespread rain also occurred in the whole of the central parts of the country on 11th, 12th and 13th. The monsoon was also active in east Rajasthan and west Madhya Pradesh.

The following statement gives the noteworthy amounts of rainfall associated with the deep depression:

Date	Station	Rainfall (cm)	Date	Station	Rainfall (cm)
10	Kamaria	14.0	11	Narayanganj	13.9
	Kanas	12.5	(Contd)	Khotaghat	12.6
11	Pushparajgarh	16.5		Balaghat	11.4
	Sarathi	14.5		Waraseoni	11.2
				Kosni	10.2

Date	Station	Rainfall (cm)	Date	Station	Rainfall (cm)
12	Lanji	14.2	13	Bonai	42.1
	Waramain	12.9	14	Maihar	14.3
	Champa	11.5			
	Selod	11.0			
	Bhikai	10.7			
	Mandla	10.5			

7. Depression in the Bay of Bengal—
—15th and 16th August—

A low pressure wave from the east was moving westwards across central Burma on the morning of 13th August. It merged into the north Bay of Bengal by the morning of 14th and a cyclonic circulation extending upto 5.4 km a.s.l. developed over the northeast Bay of Bengal. By the same evening, a low pressure area formed over the head Bay of Bengal. The pressure departures over the head Bay were about -3 to -4 mb at this time. By the morning of 15th, the low pressure area concentrated into a depression with centre near Lat. 21.0°N Long. 87.5°E.

The following observations of 15th are significant in this connection:

Name of the station	Time of observation	W i n d		Pressure (mb)	W e a t h e r
		Dir.	Speed Knots		
Sagar Island	0830	ESE	30	995.0	-
Sandheads	0830	SSE	15	995.5	Overcast
Balasore	0830	N	5	996.0	Rain

Moving northwestwards, the depression crossed north Orissa coast near Balasore during the afternoon of 15th and lay centred about 60 km northwest of Balasore at 1730 hrs IST. Continuing to move in the same direction, it was centred about 30 km southeast of Daltonganj on the morning of 16th. By the same evening it weakened into a low pressure area and lay over northeast Madhya Pradesh and adjoining east Uttar Pradesh on the morning of 17th. By the next morning, the low pressure area merged with the seasonal trough.

Under the influence of this depression, widespread rain was reported from Orissa on 15th and from Orissa, Madhya Pradesh and Bihar Plateau on 16th. Some of the noteworthy amounts of rainfall associated with this system were :

15th	Cuttack	8 cm	16th	Balasore	11 cm
	Sambalpur	7 cm		Kanker	10 cm
				Raipur	9 cm

Due to the heavy rains associated with this and the previous depression, many rivers in Bihar State, Madhya Pradesh, Uttar Pradesh and the Punjab rose in spate affecting thousands of acres of cultivated land and hundreds of villages. The bridge across the Narmada at Khalaghat on the Bombay-Agra road was reported to be 14 feet under water on 13th.

8. Land depression over Gangetic West Bengal—
—23rd to 26th August—

A low pressure wave from the east was moving into the northwest Bay of Bengal on the morning of 21st. Under its influence, a low pressure area formed over the north Bay of Bengal on 22nd morning. The associated upper air cyclonic circulation extended upto 6.0 km a.s.l. It moved westnorthwestwards and concentrated into a depression on the morning of 23rd with centre near Contai in Gangetic West Bengal. The cyclonic circulation extended upto 7.2 km a.s.l. The pressure departures from normal were of the order of -6 mb in the field of the depression. Moving westnorthwest, the depression was centred near Ranchi on the morning of 24th. Moving northwestwards, later, it was centred about 100 km south of Daltonganj on the morning of 25th and near Satna on the morning of 26th. By 26th evening, it was centred about 50 km south of Nowgong. Thereafter, weakening into a low pressure area and moving westnorthwestwards, it merged with the seasonal low by 29th.

Under the influence of this depression, active monsoon conditions prevailed in Orissa and east Madhya Pradesh on 23rd. The monsoon was also active in east Madhya Pradesh on 24th and 25th, in west Madhya Pradesh on 26th and in east Rajasthan on 27th. Some of the noteworthy amounts of rainfall were:

23	Balasore	9 cm	25	Sikar	18 cm
	Angul, Ambikapur	6 cm each.		Raigarh	11 cm
				Umaria	10 cm
24	Ambikapur, Satna	10 cm each.		Alwar, Jharsuguda	8 cm each.
	Alwar	8 cm		Sagar, Champa	7 cm each.
			26	Sheopur, Jabalpur	6 cm each.

9. Deep depression in the Bay of Bengal—
—23rd to 25th September—

On the morning of 19th September, under the influence of a low pressure wave moving from east, a trough of low pressure formed over the east central Bay of Bengal. The cyclonic circulation over the east central Bay extended upto 6.0 km a.s.l. By 20th evening, the circulation shifted to the north Bay of Bengal, where a low pressure area had formed and by the evening of 22nd it became well marked. It concentrated into a deep depression on the morning of 23rd with centre near Lat. 21.0°N, Long. 89.0°E.

The following observations of 23rd are of interest in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
AQDM	21.4	91.6	0530	SE	15	995.7	Shower
Khulna			0830	E	5	998.3	
Sagar Island			0830	NNE	20	995.1	Rain
Sandheads			0830	NW	5	994.3	Shower
Contai			0830	N	2	995.8	Rain

The maximum pressure departure was -12.8 mb at Sandheads at this time. The cyclonic circulation extended upto 7.2 km a.s.l. Moving in a westnorthwesterly direction, it was centred close to West Bengal-Orissa coast about 50 km southeast of Balasore by the evening of 23rd. Continuing to move westnorthwestwards, it crossed the north Orissa-West Bengal coast near Balasore during the early night and lay centred about 50 km southeast of Ambikapur on the morning of 24th. The easterlies to the north of the system were very strong at this time. Gaya reported easterly wind of 30, 45 and 60 km at 300, 600 and 900 m a.s.l. respectively at 0530 hrs IST on this day. The pressure departures around the system were about -10 mb and Ambikapur recorded a pressure defect of 12.5 mb. Taking a northwesterly course, the deep depression was centred near Satna on the morning of 26th. The easterlies were quite strong at 0530 hrs IST of this day also and winds were of the order of 35-45 knots at 900 m a.s.l. Gorakhpur reported SE/65 knots at 900 m a.s.l. at the same hour. Moving further northwest, the system weakened into a depression by the evening of 25th when it was centred near Mainpuri. Continuing to move in the same direction, and weakening at the same time, it lay as a low pressure area over Punjab on 26th morning and became unimportant by the next day.

The estimated lowest pressure during the life span of this system was about 991 mb at 1730 hrs IST of 23rd and the corresponding pressure defect was 14 mb.

This depression caused well distributed rainfall with a number of heavy falls in northeast India and other parts of north and central India in the course of its movement. Some of the noteworthy amounts of rainfall were : Sagar Island 12 cm on 22nd, Sandheads 16 cm and Chanda 15 cm on 23rd, Sambalpur 12 cm on 24th, Umaria 13 cm and Mukteshwar 12 cm on 25th, Aligarh 22 cm, Dalhausie 20 cm, Nautanwa 18 cm, Agra 15 cm, New Delhi, Ambala, Ludhiana and Chandigarh 14 cm each on 26th. According to press reports, the very heavy rains caused flooding of vast areas in west Uttar Pradesh and Punjab, where a number of houses were reported to have been damaged.

10. Deep depression in the Bay of Bengal— —27th to 29th September—

On the morning of 25th September, a low pressure area was lying over Thailand and adjoining Burma. The cyclonic circulation associated with this low

was extending upto about 3.0 km a.s.l. This low pressure area moved westwards and was emerging into the east central Bay of Bengal on the morning of 26th and by the evening of the same day it was lying over the east central Bay of Bengal. By the next morning, it had moved further westwards, became well marked and was lying over the central Bay of Bengal. The pressures all along the Burma coast which were falling till the previous evening, had started rising by 27th morning and simultaneously, pressures over coastal Andhra Pradesh and Tamil Nadu had started falling and the falls were of the order of 2-3 mb. By the evening of the same day, the well marked low pressure area moved further westwards and concentrated into a depression with centre near Lat. 17.0°N, Long. 85.5°E. The following observations in this connection are significant:

Date	Name of the ship/station	Position		Time of Obsn	Wind		Pressure (mb)	Weather
		Lat. °N	Long °E		Dir.	Speed Knots		
27	Vishakhapatnam			1730	ENE	15	999.0	Rain
	Kakinada			1730	WSW	5	991.1	Drizzle
	VOUE	16.2	83.0	1730	W	30	1002.3	Moderate rain
	AGVA	16.4	87.7	1730	S	15	1001.0	
	Gopalpur			1730	NE	25	at 300 m	
					NE	30	at 600 m	
					ENE	30	at 900 m	
					ENE	30	at 1.5 km	
					ENE	40	at 2.1 km	
					NE	40	at 3.0 km	

The pressure falls along the Andhra coast were about 3 to 5 mb and the departures in the fields of the depression were about -6 mb with Vishakhapatnam recording a pressure defect of 6.5 mb at this time. The cyclonic circulation associated with the depression was extending upto 6.0 km a.s.l.

The depression moved practically west during the course of the night, intensified into a deep depression and was centred near Lat. 17.0°N, Long. 83.5°E at 0830 hrs IST of 28th. The following observations of 28th are of significance in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed		
Vishakhapatnam			0830	ENE	15	1000.1	Rain
Kakinada			0830	WNW	5	999.6	Drizzle
MASC	16.4	82.8	0730	N	25	999.5	Rain
PEPK	14.7	85.2	1130	WSW	25	1001.4	Rain
Vishakhapatnam			0530	NNE	30	at 300 m	
				NE	40	at 600 m	
				NE	40	at 900 m	

The highest 24 hour pressure falls were registered at Vishakhapatnam and Kakinada which were 4.6 and 4.9 mb respectively and the corresponding pressure defects at these two stations were 8.1 and 8.8 mb respectively. The cyclonic circulation associated with the system was extending upto 7.2 km a.s.l. at this time.

Continuing to move in a westerly direction, the deep depression was centred close to Kakinada at 1730 hrs IST of the same day, when Kakinada reported surface pressure 995.6 mb which was 9.7 mb below normal.

The deep depression crossed the coast near Kakinada during the early night of 28th and lay over northeast Andhra Pradesh on the morning of 29th with centre near Khammam at 0830 hrs IST. By the evening, it had weakened into a depression with centre near Hyderabad. It further weakened into a low pressure area which was lying over Telangana and adjoining north Interior Mysore on the morning of 30th. It persisted over the same area without any appreciable movement upto 3rd October. Later, it shifted slightly northwestwards, weakened and became unimportant by 5th.

The estimated lowest pressure during the entire life period of the deep depression was 994 mb at 1730 hrs IST on 28th and the corresponding pressure defect was 11 mb.

Under the influence of this deep depression, heavy rain occurred in Andhra Pradesh and other parts of north Peninsula. Some of the heavy rainfall amounts reported were : Gannavaram 10 cm on 28th, Rentachintala 23 cm, Kurnool 13 cm and Gannavaram 12 cm on 29th and Raichur 15 cm, Sholapur 12 cm, Bijapur 11 cm and Ratnagiri, Jeur and Mahbubnagar 10 cm each on 30th. According to press reports, the heavy rains in Andhra Pradesh caused disruption of road and rail communications. More than 500 fishermen who had left Kakinada and neighbouring villages on 26th and 27th were caught in the high seas, but all except a few were later rescued.

11. Deep depression in the Bay of Bengal— —4th to 7th October—

A low pressure area was moving westwards across central Burma on the morning of 2nd October. The pressures were falling along the Arakan and Chittagong coast. The cyclonic circulation associated with the low was also observed upto 5.4 km a.s.l. sloping southwards with height. By the morning of 3rd, it was emerging into the northeast Bay of Bengal and pressure departures were of the order of -6 mb along Chittagong - Arakan coasts. There was widespread rainfall also all along coastal Burma and East Pakistan coast. By the same evening, it had emerged into the northeast Bay of Bengal and concentrated into a depression by 4th morning with centre near 21.5°N, Long. 91.0°E. Chittagong reported easterly wind of 5 kt with pressure 1003.5 mb and Cox's Bazar southerly wind of 15 knots with pressure 1003.3 mb at 0830 hrs IST on this day. The pressures along the Arakan coast had started rising by this time and the highest pressure defect of 6.9 mb was recorded at Cox's Bazar. The cyclonic circulation extended upto 7.2 km a.s.l.

Moving in a northnorthwesterly direction, it further intensified into a deep depression by 5th morning and was centred near Lat. 22.0°N, Long. 90.0°E. The following observations of 5th are significant in this connection :

Name of the station/ship	Time of Obsn. IST	Wind		Pressure (mb)	Weather
		Dir.	Speed Knots		
Barisal	0830	E	15	1000.7	
Khulna	0830	N	15	1001.2	Rain
Nakhal	0830	SE	20	1003.1	Rain
Calcutta	0830	NE	5	1002.7	Rain
Chittagong	0530	SE	30	at 300 m	
		SE	35	at 600 m	
		SE	40	at 900 m	
Calcutta	0530	N	10	at 300 m	
		N	20	at 600 m	
		NNE	20	at 900 m	
Bogra	0530	ESE	10	at 300 m	
		ESE	15	at 600 m	
		ESE	15	at 900 m	

There was a concentrated fall of pressure along the East Pakistan coast at 0830 hrs IST of this day and the highest fall of 3.9 mb was over Barisal and the pressure defect at this station was 9.0 mb. The cyclonic circulation at this time was extending upto 6.0 km a.s.l. There was ~~widespread~~ rainfall in East Pakistan, Assam and fairly widespread rainfall in West Bengal.

Continuing to move northnorthwestwards, the deep depression crossed the East Pakistan coast in the afternoon of 5th near long 90°E and was centred about 50 km north of Barisal at 1730 hrs IST. Maintaining its movements in the same direction, the deep depression was centred about 50 km north of Faridpur on the morning of 6th. It caused widespread rain with few heavy falls over Assam and East Pakistan on this day. By 1730 hrs IST, it was centred near Bogra. Thereafter, the deep depression moved in a northwesterly direction weakening at the same time. It lay as a depression on the morning of 7th with centre about 50 km southeast of Malda. The pressures all over northeast India and East Pakistan were rising on the morning of 8th and it would appear that the system was started weakening rapidly. Bogra and Mymensingh reported 22 cm of rainfall each on 7th morning. Some of the other principal reported amounts of rainfall in cm associated with this system were : Agartala 9 on 6th, Tura and Cherrapunji 11 each and Shillong 7 on 7th and Patna 13 on 9th. Moving in a westerly direction, the depression weakened into a low pressure area over Bihar Plateau and adjoining Gangetic West Bengal on 8th morning. Persisting over the same area upto 10th, it moved eastwards and became unimportant by 13th.

12. Deep depression in the Bay of Bengal— —17th to 21st October—

On the morning of 13th October, an upper air cyclonic circulation was noticed off the south Viet Nam coast and it extended upto 3.0 km a.s.l. By the

next morning, this circulation had moved westwards and was lying over the Gulf of Siam. The circulation could be seen upto 5.4 km a.s.l. Pressures were also falling over the extreme south Burma coast at the same time. By 16th morning, it had moved into the north Andaman Sea where a feeble low pressure area formed. Moving northwards, it concentrated into a depression over the east central Bay on the morning of 17th with centre near Lat. 16.0°N and Long. 89.5°E. In this connection the following observations of 17th are of interest.

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
VWDY	14.9	92.3	0530	SW	5	1008.0	
AQLM	14.6	86.9	0530	W	15	1005.0	Showers
VWLG	18.3	85.6	0530	NE	10	1009.7	Rain
VWLG	18.0	86.4	1130	N	15	1006.9	Drizzle
Mohammedi	14.5	91.2	1130	SE	5	1006.1	
Coco Island			0530	S	15	at 300 m	
				S	10	at 600 m	
				SSW	20	at 900 m	
				SSW	20	at 300 m	
Port Blair			0530	SW	20	at 600 m	
				WSW	25	at 900 m	
Akyab			0530	NE	10	at 300 m	
				SE	20	at 600 m	
				E	15	at 900 m	

Pressure falls were of the order of 2-3 mb along Andhra and Orissa coasts at this time. Moving in a westnorthwesterly direction, the depression was centred near Lat. 16.5°N, Long. 87.0°E at 1730 hrs IST of 17th. Moving thereafter, in a northwesterly direction and intensifying at the same time, it lay over west central Bay of Bengal as a deep depression on the morning of 18th with centre near Lat. 18.0°N, Long. 86.0°E. Ship VWPR at Lat. 17.2°N, Long. 86.3°E reported surface wind SW/25 kts and pressure 998.5 mb at 1130 hrs IST of 18th. Gopalpur reported surface wind NE/15 kt and pressure 1005.1 mb at 0830 hrs IST on this day. Pressure falls of the order of 3-4 mb were noticed along north Andhra and south Orissa coasts and the largest pressure defect of 6.7 mb was recorded at Kalingapatnam at this time. The upper air cyclonic circulation associated with the deep depression extended upto 5.4 km on this day. Continuing its northwesterly movement, the deep depression was centred off south Orissa - north Andhra coasts, with centre near Lat. 19.0°N, Long. 85.5°E on 18th evening. Gopalpur reported the lowest pressure of 999.2 mb at this time and the corresponding pressure defect was 9.3 mb. The deep depression crossed south Orissa coast near Gopalpur during the night of 18-19th and was centred about 80 km south of Sambalpur at 0830 hrs IST of 19th. Continuing its northwesterly movement and weakening at the same time, it lay over east Madhya Pradesh on the morning of 20th as a depression with centre about 40 km south of Champa. Thereafter, the depression started recurving towards

the northeast and lay on the morning of 21st over northeast Madhya Pradesh with centre about 130 km east of Ambikapur. Thereafter, it weakened into a low pressure area and moved away northeastwards across Assam by 24th.

The estimated lowest pressure associated with this system was 998 mb at 0830 hrs IST of 18th and the corresponding pressure defect was about 13 mb.

In the course of movement of this deep depression, fairly well distributed rainfall occurred in coastal Andhra Pradesh and east Madhya Pradesh. There was also a spell of good rainfall over northeast India for nearly a week from the 18th. Some of the significant amounts of rainfall were : Raipur 12 cm and Champa 7 cm on 20th, Cooch Behar 16 cm on 21st, Sriniketan 18 cm and Pasi-ghat 12 cm on 22nd.

13. Severe cyclonic storm in the Arabian Sea— —2nd to 8 November—

An upper air cyclonic circulation developed off Kerala - Mysore coasts on the morning of 1st November and extended upto about 6.0 km a.s.l. A well marked trough of low pressure could also be noticed on the sea level chart, off Kerala - Mysore coasts at the same time. By the evening of 1st, a low pressure area formed over the Laccadive area and by the morning of 2nd, it concentrated into a depression with centre near Lat. 9.5°N , Long. 72.0°E . Minicoy reported westerly wind of 5 kt and Amini Divi light eastsoutheasterly wind. Ship JHVD at Lat. 8.6°N , Long. 69.5°E reported northwesterly wind 15 kt with continuous rain and pressure 1008.0 mb at 0530 hrs IST. Ship JEQE at Lat. 8.2°N , Long. 72.3°E reported westerly wind of 20 kt with showers and pressure 1009.7 mb at the same time. The upper winds at Minicoy were WSW/15 kt, WSW/25 kt, WSW/25 kt and WSW/25 kt at 300, 600, 900 m and 1.5 km a.s.l. Moving in a westerly direction, the depression was centred near Lat. 10.0°N , Long. 69.0°E on the morning of 3rd. Amini Divi reported surface wind light southeasterly and pressure 1008.1 mb at 0830 hrs IST on this day. Ship JCQS at Lat. 8.9°N , Long. 68.6°E reported westerly wind 20 kt at 0530 hrs IST. By the evening of 3rd, the depression had intensified into a deep depression and was centred within half a degree of Lat. 10.0°N , Long. 68.0°E . In this connection, the following observations of 3rd are significant.

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	W e a t h e r
	Lat. $^{\circ}\text{N}$	Long $^{\circ}\text{E}$		Dir.	Speed, Knots		
FNFY	11.6	65.7	1730	WNW	30	1006.5	Precipitation within sight
Kampala	10.5	66.3	1730	NNW	25	1003.5	Showers
GMSS	8.4	72.0	1730	W	15	1006.2	Showers
Minicoy			1730	W	5	1007.1	
Amini Divi			1730	SE	Light	1005.9	
Minicoy			1730	WSW	20	at 300 m	
				W	20	at 600 m	
				W	20	at 900 m	
				W	25	at 1.5 km	

After 3rd evening, the deep depression took a westnorthwesterly course and was centred at Lat. 10.5°N, Long. 67.0°E on the morning of 4th, as could be judged from the observations of the following ships.

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
VWVP	11.3	67.4	0530	E	20	1003.8	
GCXX	12.8	68.0	0530	ESE	25	1003.4	Showers
Heimaru	9.5	64.0	0530	N	10	1007.7	
GMSS	8.9	68.4	0530	WSW	15	1004.0	Showers
FMFX	10.3	70.4	0830	SSW	25	1007.5	
VWVP	11.4	66.5	1130	E	20	1003.6	

Moving in a northwesterly direction, the deep depression intensified into a cyclonic storm during the course of the day and was centred near Lat. 11.0°N, Long. 66.0°E at 1130 hrs IST of 4th. The following ships' observations of 4th are significant in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
VWVP	10.5	66.0	1730	W	35	1001.5	
GMSS	9.2	65.1	1730	W	30	1004.7	Showers
JEQU	10.0	61.3	1730	NNW	15	1008.5	
GCKX	15.0	69.4	1730	E	10	1007.3	

Continuing to move in a northwesterly direction, the cyclonic storm was centred within half a degree of Lat. 11.5°N, Long. 65.0°E at 0830 hrs IST of 5th. There were no ships close to the storm field and only one ship VWVP at Lat. 8.3°N, Long. 64.4°E reported WNW wind 30 kt at 0530 hrs IST. By the evening of the same day, the storm was centred near Lat. 12.5°N, Long. 64.0°E. Ship GNCS at Lat. 10.0°N, Long. 62.5°E reported WNW wind 20 kt. Ship Sangreigorio at Lat. 10.3°N, Long. 64.7°E reported surface wind WSW force 7 (30 kt), rough seas, moderate swell from westerly direction and occasional rain squalls at 2330 hrs IST. On the morning of 6th, there were no ships in the storm field to fix the position of the storm with much accuracy. From the available observations, it would appear that the storm was centred within one degree of Lat. 13.0°N, Long. 62.0°E. Again on the evening of 6th, there were no ships' observations available from the storm field. Ships far away near Lat. 18° - 20°N reported northeast winds of 25 kts. Ship PEPK at Lat. 9.5°N, Long. 63.3°E reported surface wind WSW/20 kt pressure 1006.5 mb and drizzle and ship GHNV at Lat. 8.1°N, Long. 59.2°E reported surface wind NW/15 kt and pressure 1009.8 mb at 1730 hrs IST. Judging from the isobaric gradient, it would appear that

the system had intensified into a severe cyclonic storm during the course of the day and was centred within a degree of Lat. 13.0°N, Long. 61.0°E at 1730 hrs IST of 6th. Afterwards, the storm seems to have taken a westsouthwesterly course and was centred within a degree of Lat. 13°N, Long. 60°E on 7th morning. There was no ship near the centre of the storm. However, the following observations of 7th are of interest:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
PEKP	10.0	60.2	0530	WSW	25	1005.8	Drizzle
FOEM	14.7	53.6	0530	NE	20	1013.0	
GHN	8.1	59.0	1130	SW	20	1009.1	
FOEM	15.1	56.5	1130	NNE	15	1014.5	

The severe cyclonic storm took a southwesterly course afterwards and was centred on the evening of 7th within a degree of Lat. 12°N, Long. 59°E. Ship ICOU at Lat. 10.2°N, Long. 56.5°E reported northwesterly wind 15 kt, pressure 1008.6 mb and rain at 1730 hrs IST. Ship PCPE at Lat. 9.9°N, Long. 62.0°E reported westsouthwesterly wind 25 kt, pressure 1006.4 mb and shower. Ship GDGL at Lat. 17°N, Long. 56°E reported NE wind 20 kt pressure 1012.0 mb and clear sky at 1730 hrs IST, corroborating the movement of the system towards the south.

By the morning of 8th, the severe cyclonic storm had probably weakened into a cyclonic storm and was centred near Lat. 11.5°N, Long. 57.5°E and by the evening of the same day near Lat. 10.5°N, Long. 57.0°E. There were two ships fairly close to the system at this time. Ship GDBI at Lat. 11.2°N, Long. 55.5°E reported northerly wind 30 kt with pressure 1007.1 mb and overcast skies at 1730 hrs IST. Another ship JHAW at Lat. 11.7°N, Long. 55.8°E reported northerly wind 35 kt with pressure 1008.0 mb and overcast skies. The ship also reported wave of 3.5 m height. Later on, the system seems to have weakened into a depression. There were no ships' observations to fix the centre of the system with any confidence after 8th evening.

During the latter half of the life of the storm, there were very few ships' observations in its vicinity and as such the positions could not be fixed very critically. For the same reasons, the highest barometric depth associated with this system could not also be estimated.

14. Severe cyclonic storm in the Bay of Bengal— —3rd to 8th November—

On 1st November, the seasonal trough was well marked over the south Bay of Bengal and the trough line was running along Lat. 10°N. At the same time, a low pressure wave was moving westwards across the Gulf of Siam. By the evening of 2nd, a low pressure area formed over the south Andaman Sea. On 3rd morning it became well marked and the associated upper air cyclonic circulation ex-

tended upto 3.0 km a.s.l. The Báy Island stations reported widespread rainfall. By the evening of 3rd, the well marked low pressure area concentrated into a depression with centre near Lat. 8.0°N, Long. 95°E. The following observations of 3rd are significant in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	W e a t h e r
	Lat. °N	Long °E		Dir.	Speed Knots		
Nancowry			1730	N	30	1003.5	Continuous rain
VWDX	10.1	90.0	1430	NNW	10	1004.5	Continuous rain
GBKE	5.6	93.5	1730	SW	25	1004.9	Showers
Port Blair			1730	NE	20	at 300 m	
				ENE	20	at 600 m	
				ENE	20	at 900 m	
				ENE	25	at 1.5 km	

Moving in a northwesterly direction, the depression was centred near Lat. 10.5°N, Long. 92.5°E on the morning of 4th. Port Blair reported surface wind E/10 kt with continuous rain. The 24 hour pressure fall at Port Blair was 3.4 mb and the pressure departure was -6.1 mb. Moving northwards, the depression was centred near Lat. 12.5°N, Long. 92.5°E on the evening of 4th. Moving in a westerly direction and intensifying at the same time, it lay as a deep depression on the morning of 5th over the southeast and adjoining east central Bay of Bengal with centre near Lat. 13°N, Long. 89.5°E. Ship VWQS at Lat. 13.6°N, Long. 86.5°E reported surface wind N/20 kt with continuous drizzle at 1130 hrs IST. Continuing to move in a westerly direction, the deep depression intensified into a cyclonic storm during the course of the day and was centred at 1730 hrs IST near Lat. 13°N, Long. 87.5°E. Ship VWQS at Lat. 14.1°N, Long. 86.7°E reported surface wind ENE/30 kt, pressure 995.8 mb and moderate continuous rain at 1430 hrs IST. Ship VWZM at Lat. 10.0°N, Long. 83.3°E reported surface wind NW/25 kt and pressure 1004.6 mb at 1730 hrs IST. The upper air cyclonic circulation associated with the system extended upto 6.0 km a.s.l. at this time. By the morning of 6th, pressures started falling along the Andhra - Madras coast and the falls were of the order of 2 - 3 mb. Upper winds over Madras and Gannavaram had also strengthened by this time. The cyclonic storm was moving in a westerly direction and was centred on 6th morning with centre near Lat. 13°N, Long. 85°E. The following observations of 6th are significant in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	W e a t h e r
	Lat. °N	Long °E		Dir.	Speed Knots		
VWZM	11.2	84.0	0530	NW	30	1000.8	
VWQS	16.2	88.0	0530	E	20	1002.7	Drizzle
GVJF	11.4	89.1	0530	SE	20	1002.7	Shower
VWEW	11.6	84.8	0930	NW	35	1002.7	

Continuing to move in a westerly direction, the cyclonic storm further intensified into a severe cyclonic storm and was centred at 1730 hrs IST of 6th near Lat. 13.0°N , Long. 84°E . The following observations of 6th are of interest in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. $^{\circ}\text{N}$	Long $^{\circ}\text{E}$		Dir.	Speed Knots		
VWZM	11.1	84.0	1730	W	40	999.2	
KEHQ	9.8	84.8	1730	WSW	15	1002.8	
VWJC	16.0	82.2	1730	NE	27	1002.4	
GBZT	13.1	80.3	1730	WNW	15	1002.7	Intermittent rain
VWZM	11.3	83.9	1930	WSW	40	1001.0	

Moving further westwards, the severe cyclonic storm was centred on the morning of 7th near Lat. 13°N , Long. 81.5°E . There was a fall of pressure all over the peninsula and heavy falls of pressure were noticed along north Madras and south Andhra coasts. Madras reported 4.9 mb pressure fall and Nellore 4.3 mb. Upper winds at Madras were NNEly 40 kts at 300, 600 and 900 m a.s.l. The following observations from the storm field of 8th are also significant:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. $^{\circ}\text{N}$	Long $^{\circ}\text{E}$		Dir.	Speed Knots		
GBHL	11.2	81.2	0530	W	35	1002.2	Overcast
VMZM	11.9	83.2	0530	SW	25	1001.8	
GBHL	11.0	81.2	0830	W	35	1004.3	Overcast
Madras			0830	NW	20	1003.3	Rain
GBZT	13.0	81.5	1130	NE	25	1002.5	Drizzle
PGDG	11.5	81.5	1130	W	30	1001.8	Rain
GBHL	11.4	81.0	1130	WSW	35	1002.7	Rain
VWZM	12.2	84.1	1130	SE	25	1006.0	

After 7th morning, the severe cyclonic storm took a westsouthwesterly course and started weakening into a cyclonic storm. By the evening, there was pressure rise corrected for diurnal variation since 0830 hrs IST over the south Peninsula. The upper winds at Madras had also weakened. They were NE/20 kt at 300 m, ENE/20 kt at 600 m and ENE/25 kt at 900 m a.s.l. Madras reported surface wind ENE/10 kt with pressure 1002.1 mb and Cuddalore W/10 kt with pressure 1002.5 mb and rain at 1730 hrs IST. Ship GBHL at Lat. 11.0°N , Long. 80.4°E reported surface wind WSW/20 kt at the same time. The system lay as a cyclonic storm close to Madras coast near Lat. 12.5°N , Long. 80.5°E on the evening of 7th. Maintaining its westsouthwesterly course, the cyclonic storm crossed Madras coast

south of Madras on the morning of 8th, weakened and lay as a depression about 50 km southsouthwest of Madras at 0830 hrs IST. At this time, the pressure along the Madras coast had started rising rapidly. The depression weakened in situ into a low pressure area by the same evening and became unimportant the next day.

The estimated lowest pressure during the life span of this storm was 990 mb at 1730 hrs IST of 6th and the corresponding pressure defect was of the order of 20 mb.

Widespread rainfall in the south Peninsula was reported on 7th and 8th. Some of the noteworthy amounts of rainfall were :

7th	Madras	7 cm
	Tirupattur	6 cm
	Vellore	5 cm
	Cuddalore	5 cm
8th	Bangalore CO	7 cm

Under the influence of the storm and heavy rain, many low lying areas of Madras City were inundated. Over 70 huts in the Foreshore Estate were damaged. The river Adyar had swollen and as a result, a number of washermen's huts near the Narmalong bridge were submerged. Due to squally winds on 6th, many trees were uprooted and public transport was dislocated. Though no loss of life was reported, a few persons were injured in the collapses due to heavy rain in Madras City.

15. Severe cyclonic storm in the Bay of Bengal—
—16th to 28th Nov.—

On 11th November, a low pressure wave from the east was moving westwards across the Gulf of Siam. On the morning of 12th, it moved into the south Andaman Sea, where a low pressure area formed. Moving westnorthwestwards, it was lying over the southeast and adjoining central Bay of Bengal on 13th morning. The cyclonic circulation associated with this low extended upto 2.1 km a.s.l. On 15th morning, it lay over the central and adjoining south Bay of Bengal and was well marked. It concentrated into a depression on the morning of 16th and lay over the west central and adjoining southeast Bay of Bengal with centre near Lat. 13.5°N, Long. 85.5°E. The following observations of 16th are significant in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Dir.	Speed Knots		
VWBN	14.5	85.3	0530	ENE	10	1005.8	
VWPD	10.5	86.4	0530	WSW	10	1007.7	
AQLN	9.7	84.1	0530	NW	10	1008.3	
PEEM	12.9	84.9	1130	W	10	1006.5	
No name	14.9	85.6	1130	E	10	1007.7	
VWRX	16.2	86.0	1130	ESE	10	1009.7	Squall
VWRD	11.2	82.6	1130	W	20	1009.9	

Moving westwards, it was centred on the morning of 17th near Lat. 13.5°N, Long. 84.0°E and by the evening of the same day it was centred near Lat. 13.5°N, Long. 83.5°E. Continuing to move in a westerly direction, it intensified into a cyclonic storm of small extent and was centred near Lat. 13.5°N, Long. 82.5°E on the morning of 18th. The following observations of 18th are of interest in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
City of Swan sea	16.3	83.0	0530	E	20	1008.6	Overcast
GPHR	14.9	82.0	0530	ENE	15	1008.6	Overcast
VWBT	15.0	85.5	0530	ESE	20	1009.9	
Masulipatnam			0830	ENE	2	1013.1	Rain
Nellore			0830	NW	2	1012.8	Overcast
Madras			0830	NW	5	1012.3	Rain
Madras			0530	E	15 at	300 m	
				NNE	15 at	600 m	
				NE	15 at	900 m	
				N	15 at	1.5 km	
				N	15 at	2.1 km	

Moving in westsouthwesterly direction, the cyclonic storm further intensified into a severe cyclonic storm and was centred near Lat. 13.0°N, Long. 81.5°E at 1730 hrs IST of 18th. The observations on 18th in the vicinity of the system at this time are reproduced in the following table:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
Negobolo	12.7	81.6	1500	NW	45	999.2	Rain
Indian Industry	10.9	81.1	1730	SW	15	1008.9	Squall
AQEM	12.0	84.6	1730	S	10	1009.6	-
Madras			1730	N	5	1009.1	Drizzle
Cuddalore			1730	NW	5	1008.8	
Negobolo	12.7	81.3	2030	W	45	999.5	Rain
Negobolo	12.7	81.3	2200	SW	45-50	996.0	"Heavy sea rain. Cyclone 55 miles north of my position. Moving WNW very slowly."
Negobolo	12.5	81.5	2240	SW	35-40	997	Sea moderate. No rain. Visibility good.
Madras			1730	N	25 at	300 m	
				NNE	25 at	600 m	
				NNE	25 at	900 m	
				NNE	25 at	1.5 km	

Continuing to move in a westsouthwesterly direction, the severe cyclonic storm was centred on the morning of 19th close to Madras coast near Lat. 13°N, Long. 81°E. By this time, the system was associated with a core of hurricane winds. An exhaustive detail of the ships' observations available in the field of the storm on 19th are given in the following table:

Name of the ship	Position		Time of Obsn. IST	Wind		Pressure (mb)	W e a t h e r
	Lat. °N	Long °E		Dir.	Speed Knots		
AQBQ	13.6	80.8	0530	NE	35		Overcast
VWLG	12.5	80.6	0530	WSW	30	1003.9	Rain
VWMM	12.2	80.6	0530	W	30	1005.0	Rain
GHTH	12.0	82.5	0530	S	10		Rain
City of Alma	12.8	80.9	0530	WSW	70	992.4	Rain
City of Alma	12.6	81.0	0700	SW Hurricane winds		992.4	Very heavy rain and rough seas. Visibility zero. Ship near eye of storm. Sea rough. Heavy swell. Overcast. Occasional squalls. Slight sea. Moderate swell.
				Force 12			
VWV	12.1	81.5	0700	SW	70	999.9	
VWQT	11.3	81.3	0634	W	16		
VWLG	12.1	80.6	0830	WSW	30	1008.2	Rain
GMTJ	12.1	82.3	0830	SSE	15		Rain
Madras			0830	N	15	1008.7	Rain
AQBQ	13.1	80.9	1130	W	50	996	Rain
VWLG	11.8	80.9	1130	WSW	20	1011.9	Drizzle
AQEM	9.2	83.5	1130	SW	10	1010.9	
Madras			0530	N	45 at 300 m		
				N	45 at 600 m		
				N	50 at 900 m		
				N	25 at 1.5 km		
				N	45 at 2.1 km		

Even though the severe cyclonic storm was centred so close to Madras coast on the morning of 19th, the highest pressure departure of -4.2 mb was recorded at Madras at 0830 hrs IST of 19th, confirming the fact that the system was of a very small extent. Madras recorded 10 cm of rain and Nellore 8 cm for the 24 hours ending at 0830 hrs IST of 19th.

The severe cyclonic storm started moving slowly in southsouthwesterly direction and was centred on the morning of 20th close to Madras coast near Lat. 12.5°N, Long. 80.5°E. The following observations of 20th are significant in this connection :

Name of the ship/station	Position		Time of Obsn. IST:	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
LAVV	12.7	80.9	0830	SE	10-11 B.F.	1007.0	Very rough sea. Heavy swell. Heavy showers. Visibility poor.
Madras			0830	N	5	1009.2	Rain
Cuddalore			0830	NW	2	1008.9	Rain
Madras			0530	NNE	25 at 300 m		
				NNE	30 at 600 m		
				NE	30 at 900 m		
				NE	25 at 1.5 km		

Madras recorded 9 cm of rain for the 24 hrs ending at 0830 hrs IST of 20th.

The severe cyclonic storm later took an easterly course and was centred on the evening of 20th near Lat. 12.5°N, Long. 81.5°E. Ship VWMM at Lat. 12.6°N, Long. 81.3°E reported wind E/30 kt, pressure 1004 mb and rough sea at 1615 hrs IST. Ship Indian Merchant at Lat. 12.8°N, Long. 80.7°E reported wind NNE/30 kt and rain at 1730 hrs IST. At the same time, ship GHTE at Lat. 12.8°N, Long. 81.7°E reported wind E/25 kt pressure 1005.0 mb and rain. At this time, the system had apparently weakened into a cyclonic storm. Continuing to move in an easterly direction, the storm was centred near Lat. 12.5°N, Long. 82.0°E on the morning of 21st. Ship JUPJ, which originated a message at 03 hrs Local Time stated that it crossed cyclonic storm about 110 miles 120° from Madras and that the centre diameter was 100 miles. The storm later took a southeasterly course and was centred near Lat. 10.5°N, Long. 83.5°E on the morning of 22nd. The following observations of 22nd are of interest in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
VWVW	11.6	81.7	0530	NW	30	1003.6	Drizzle
VWVR	8.5	82.6	0530	WSW	20	1006.7	Showers
LMOM	11.0	83.5	0830	ENE	35	1005	Rain
Trincomalee			0830	WNW	10	1009.7	Drizzle
Nagapattinam			0830	N	10	1011.0	
Cuddalore			0830	NE	5	1010.5	

Continuing to move southeastwards, the cyclonic storm was centred on the morning of 23rd near Lat. 10°N , Long. 84°E and started weakening. Changing its course and moving in a northnortheasterly direction, it lay as a deep depression with centre near Lat. 11°N , Long. 84.5°E on the morning of 24th. Continuing to move in the same direction and weakening into a depression, it was centred near Lat. 12.5°N , Long. 85.0°E on the morning of 25th. Thereafter, the depression moved in an easterly direction under the influence of an upper level trough in the westerlies and was centred near Lat. 13.5°N , Long. 87.5°E ; Lat. 13.5°N , Long. 89.5°E ; Lat. 13.5°N , Long. 94.0°E at 0830 hrs IST of 26th, 27th and 28th respectively. It was centred near Lat. 13.5°N , Long. 96°E on the evening of 28th. Thereafter it weakened into a low pressure area over the north Andaman Sea by the 29th.

Under the influence of this system, a spell of good rain occurred in the south Peninsula during the period 19th to 21st. Madras City, in particular, had very heavy rain for three consecutive days, the rainfall recorded being 10 cm on 19th and 9 cm each on 20th and 21st. The Bay Islands also experienced fairly widespread rain on 27th and local rain on 28th. Port Blair recorded 3 cm of rain on 26th and 2 cm on 27th and Maya Bandar 2 cm on 28th. According to press reports, over 500 huts were submerged and 30,000 people were rendered homeless in Madras City because of the heavy rains. A few persons were also reported to have lost their lives.

The estimated lowest pressure during the life history of the storm was 992 mb at 0700 hrs IST on 19th and the corresponding pressure defect was of the order of 21 mb.

16. Severe cyclonic storm in the Bay of Bengal—
—17 to 24 December—

A low pressure area from the east was moving into south Andaman Sea on 15th December. By the next morning, it had moved into the south Andaman Sea. All the stations in the south Bay Islands reported rain on the morning of 16th. By the evening of the same day, a low pressure area formed over the south Andaman Sea. By the morning of 17th, the low pressure area concentrated into a depression with centre near Lat. 5°N , Long. 93°E . Heavy clouding, rain and squally weather was noticed all along the belt of Lat. $4-6^{\circ}\text{N}$, between Long. 85° and 97°E . It remained practically stationary till the morning of 18th and moving westwards later, intensified into a deep depression by 19th morning when it was centred near Lat. 5°N , Long. 92°E . The following observations are of interest in this connection :

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. $^{\circ}\text{N}$	Long. $^{\circ}\text{E}$		Dir.	Speed Knots		
JMAG	7.4	90.5	0530	E	25	1005.5	Rain
GMSN	6.9	92.1	0530	ENE	15	1005.1	Rain
PEDE	5.9	91.0	0530	N	5	1001.8	Showers
PHZI	4.5	90.2	1130	NW	15	1005.5	Overcast
Nancowry			0830	E	5	1009.6	Overcast

The deep depression had further intensified into a cyclonic storm by the evening of 19th near the same location. Ship PHKH at Lat. 5.7°N, Long. 92.2°E reported wind ENE/30 kt and showers at 1730 hrs IST of this day. Continuing to move in a westerly direction, it further intensified into a severe cyclonic storm with a core of hurricane winds by the morning of 20th and was centred near Lat. 5.2°N, Long. 91.0°E. The following observations of 20th are of interest in this connection:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Dir.	Speed Knots		
No name	5.8	90.9	0530	ENE	56	1000.5	Overcast
Tjebodas	5.3	93.1	0530	ESE	20	1004.9	Rain
GJKE	6.0	88.2	0530	NE	10	1005.6	Squall

At 1500 hrs IST of 20th, Ship CLYTOVENS (CMQG) at Lat. 6.0°N, Long. 91.5°E reported pressure 995 mb, strong ESE gale, force 9, veering, very rough sea, heavy swell, frequent heavy rain squalls, and visibility less than 2 miles. Another ship HALLE (DAYF) at Lat. 5.9°N, Long. 91.8°E reported at 1530 hrs IST ESEly wind 35 kt. The severe cyclonic storm was moving in a westnorthwesterly direction, and was centred at 1730 hrs IST near Lat. 5.5°N, Long. 90.0°E. The following ships' observations of 20th are also significant:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Dir.	Speed Knots		
Glenlyon	6.0	90.7	1730	SSE	45	993.0	Shower
JPLQ	5.7	91.3	1730	SSW	23	1003.5	Rain
GMXG	6.0	92.0	1730	ESE	35		Shower
Starbetelgens	5.6	87.1	1730	N	15	1006.7	Shower

Continuing to move in a westnorthwesterly direction, the severe cyclonic storm was centred near Lat. 6°N, Long. 88°E at 0830 hrs IST of 21st as could be inferred from the following ships observations:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long. °E		Dir.	Speed Knots		
Patrics	6.0	87.3	0700	N	50	986.4	
HPVN	5.4	87.9	0530	W	60	1004.5	
JGNK	5.9	89.7	0530	SE	35	1004.6	Showers
Astyanex	6.0	91.4	0530	ESE	20	1008.7	Rain

The severe storm moved rapidly westnorthwestwards and lay over the southwest Bay of Bengal centred near Lat. 7°N, Long. 84°E at 0830 hrs IST of 22nd. At 1130 hrs IST ship S.S.Arabia (Lat. 9.3°N, Long. 82.8°E) reported wind ENE/55 knots and at 1330 hrs IST (Lat. 9.5°N, Long. 83.2°E) reported wind ESE/50 kt with

squall. Surface pressure along the east coast of Ceylon and Madras coast had started falling on 22nd morning. By 1330 hrs IST surface wind along the east coast of Ceylon strengthened. Trincomalee reported surface wind NW/20 kt while Batticoloa W/25 kt at this time. The severe storm started taking a northwesterly course and was centred at 1730 hrs IST of 22nd near Lat. 9.0°N, Long. 82.0°E. The following observations of 22nd are of interest:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
Patrics	6.0	87.3	0700	N	50	986.4	
HPVN	5.4	87.9	0530	W	60	1004.5	
JGNK	5.9	89.7	0530	SE	35	1004.6	Showers
Astyanex	6.0	91.4	0530	ESE	20	1008.7	Rain

The severe storm moved rapidly westnorthwestwards and lay over the southwest Bay of Bengal centred near Lat. 7°N, Long. 84°E at 0830 hrs IST of 22nd. At 1130 hrs IST ship S.S.Arabia (Lat. 9.3°N, Long. 82.8°E) reported wind ENE/55 knots and at 1330 hrs IST (Lat. 9.5°N, Long. 83.2°E) reported wind ESE/50 kt with squall. Surface pressure along the east coast of Ceylon and Madras coast had started falling on 22nd morning. By 1330 hrs IST surface wind along the east coast of Ceylon strengthened. Trincomalee reported surface wind NW/20 kt while Batticoloa W/25 kt at this time. The severe storm started taking a northwesterly course and was centred at 1730 hrs IST of 22nd near Lat. 9.0°N, Long. 82.0°E. The following observations of 22nd are of interest:

Name of the ship/station	Position		Time of Obsn. IST	Wind		Pressure (mb)	Weather
	Lat. °N	Long °E		Dir.	Speed Knots		
Batticoloa			1730	WSW	25	1002.9	Rain
Jaffna			1730	NNE	20	1007.5	Overcast
S.S.Arabia	10.1	83.4	1730	ESE	35	1008.8	

Ship S.S.Muiderkerk (PGBR) which was moving southwards from Lat. 12°N along the east coast of Ceylon on 22nd reported valuable observations. These observations are given below :

Position		Time IST.	Wind		Pressure (mb)	Weather
Lat. D M °N	Long. D M °E		Dir.	Speed Knots		
12 01 80 41		0001	NE	10	1012.8	Variable sky, Sea smooth.
11 55 80 46		0100	NE	10	1011.7	Mainly cloudy, Sea smooth.
11 27 80 52		0200	NE	10	1011.8	Mainly cloudy, Sea smooth.
11 11 80 58		0300	NE	15	1010.6	Mainly cloudy, Sea slight.
10 53 81 03		0400	NE	15	1010.3	Overcast, Sea slight.
10 38 81 10		0500	NE	15	1010.6	Overcast, Sea slight.
10 21 81 16		0600	NE	15	1009.6	Overcast, Sea slight.
10 02 81 22		0700	NE	15	1009.0	Drizzle, Sea slight.
09 47 81 27		0800	N	15	1008.9	Drizzle, Sea slight.
09 31 81 33		0900	N	20	1008.3	Rain, Moderate sea.
09 14 81 39		1000	NNW	25	1007.1	Rain, Rough Sea.
08 58 81 46		1100	NNW	25	1005.9	Rain, Rough Sea.

Position		Time IST.	Wind		Pressure (mb)	Weather
Lat. D M °N	Long. D M °E		Dir.	Speed Knots		
08 43 21	51	1200	NNW	30	1001.9	Rain, Very rough Sea.
08 26 81	56	1300	NW	45	997.5	Rain, Very rough Sea.
08 10 82	00	1400	W	50	994.3	Rain, Very rough Sea.
07 51 82	05	1500	W	45	997.1	Rain, Very rough Sea.
07 39 82	10	1600	WSW	35	1002.1	Rain, High seas.
07 29 82	12	1700	SSW	20	1005.6	Rain, Moderate Sea.
07 01 82	12	1800	SW	20	1006.6	Overcast, Moderate Sea.
06 44 82	05	1900	S	15	1006.8	Overcast, Slight Sea.
06 30 81	54	2000	SSE	15	1007.0	Overcast, Slight Sea.
06 18 81	40	2100	S	10	1006.4	Overcast, Smooth Sea.
06 06 81	26	2200	SW	10	1006.2	Overcast, Smooth Sea.
06 00 81	11	2300	W	15	1006.3	Variable Sky, Smooth Sea.

The 24 hour pressure change (at 1730 hrs IST of 22nd) was of the order of -3 to -7 mb along the east coast of Ceylon. Batticaloa reported a fall of 7 mb. The severe cyclonic storm now took a westnorthwesterly course and moving across the extreme north of Ceylon, was centred on the morning of 23rd near Lat. 9.5°N, Long. 80°E. Jaffna reported surface wind ESE/20 kt and pressure 1006.4 mb and Vedaranniyam NNW/15 kt and pressure 1007.7 mb at 0830 hrs IST. No upper wind observations from Ceylon and south Madras are available.

Ship INS Sharda which was at Mandapam on 23rd recorded the lowest pressure of 993.6 mb at 0900 hrs IST. Continuing to move westsouthwest, the severe cyclonic storm crossed the Madras coast south of Tondi on the afternoon of 23rd, weakened into a cyclonic storm and was centred near Madurai at 1730 hrs IST of 23rd. Madurai reported surface wind NW/40 kt and pressure 1001.7 mb at this time. The pressure departure at Madurai at this time was -8.5 mb. Later, it rapidly weakened into a depression, moved westwards across the south Peninsula and emerged into the southeast Arabian Sea, where it was centred near Lat. 10.5°N, Long. 74.5°E on the morning of 24th. It later weakened into a low pressure area and continuing to move westwards became unimportant by 26th.

The estimated lowest pressure and the corresponding departure from normal during the entire life period of the storm was 970 mb and -38 mb respectively at 0830 hrs IST of 23rd.

Under the influence of the severe cyclonic storm, widespread rain occurred in the south Bay Islands between 17th and 21st December, Kondul recorded 8 cm of rain on 17th and 6 cm on 19th and Nancowry 8 cm on 18th and 5 cm on 19th. South Peninsula experienced fairly widespread rainfall on 23, 24 and 25th. Vedaranniyam reported 10 cm and Tondi 8 cm on 23rd, Madurai 23 cm, Kodaikanal 19 cm, Ootacamund 11 cm, Kallakkurichchi 9 cm, Coonoor 8 cm and Nagapattinam 7 cm on 24th and Tondi 8 cm on 25th.

According to press reports, the cyclonic storm caused severe devastation at Dhanushkodi - a place on Rameswaram Island which stretches east to west between the Palk Strait and the Gulf of Mannar. At Dhanushkodi, winds of hurricane force raging for a period of about six hours from the midnight of 22nd to 23rd morning caused immense damage to the houses, huts and trees. Almost all the dwelling places at Dhanushkodi were razed to the ground and coconut trees were destroyed. A passenger train which left Rameswaram road station near about midnight of 22nd was

washed off by the tidal waves sometime later. About 120 passengers travelling by this train met a watery grave. The Pamban bridge connecting Mandapam with Rameswaram Island was washed away by the tidal waves. According to the estimate of the touring officer who visited the cyclonic devastated areas, the tidal waves must have been about 3 metres high for about four hours reaching peak height of 5 metres for a short time. The death toll was estimated to be about 500 persons including the passengers in the ill-fated train. The loss of cattle was very large. The total loss was estimated to be nearly eight crores of rupees.

According to the estimate of the touring officer, the eastwest diameter of the eye of the storm was not more than 10 miles.

The following is an extract of the report on the cyclone which passed over Dhanushkodi on 23rd December by Mr.S.Subhiah, in-Charge, Operator, H.C. & I., Dhanushkodi Police Radio Station:

"On 22.12.64, there was a strong wind blowing at about 1800 hrs onwards from northeast side. The sky was clear. There was no rain and there was no hint of any storm or cyclone which would hit Dhanushkodi in the night.....From 10 P.M. onwards, the velocity of the wind increased gradually and still there was no rain. At 11 P.M., there was a high whistling sound with hissing and rain began to pour down. Due to the pressure of the wind which had by this time approached to cyclonic proportions, waves were bigger and higher and at about 12 O'clock midnight the fourth house to mine collapsed due to water and wind.....soon several huts began to collapse and people were running for shelter at the railway station and railway carriages. By this time, the cyclone was increasing in its tempo and waves were rising to a height of 40-50 ft and breaking on the land. Though it was dark, the white foam on the top of the high waves could be seen and that was how the height of the waves could be judged. At this time, rain was falling like a sheet of water and the wind was blowing at cyclonic speed. Huts were collapsing and people were running helter and skelter to save themselves. There was no time to rescue their belongings as the water was rising high and practically everything was washed away. There are three pucca buildings at Dhanushkodi, one with terraced roof and two with asbestos roofs. Due to the cyclone roofings of the asbestos roofed buildings were blown away.....the wind, rain and tidal waves continued unabated till about 6.00 A.M. At this time wind and rain decreased a little. About 6.30 AM both the wind and rain stopped completely within a very short time, cyclone wind began to blow from southwest with the same intensity but without rain. Except for a few collapsed huts near the railway station all other huts were washed away.....By about 11 A.M. of 23rd, I could contact Madras and inform the fate which had befallen Dhanushkodi."

The severe cyclonic storm also caused unprecedented floods in Ceylon. Trincomalee was ravaged by hurricane winds but reports of devastation caused in Ceylon are not available.

Table II

Monthly distribution of cyclonic storms and depressions in the
Bay of Bengal and Arabian Sea 1964

Month	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Total	
Distur- bance	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C
Bay of Bengal									1			1		3		2		2			2 (2)		1 (1)		8	4 (3)
Arabian Sea											1 (1)			1							1 (1)	1			1	3 (2)
Land Dep- ression														1											1	
Total									1		1 (1)	1		4	1	2		2			3 (3)	1		1 (1)	10	7 (5)

D = Depression

C = Cyclonic storm

Figures in brackets indicate
severe cyclonic storms

TRACKS OF STORMS AND DEPRESSIONS (IN THE INDIAN SEAS)

1964

